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SILVICAL
*Characteristics*
OF...

# SLIPPERY ELM

(*Ulmus rubra*)

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U.S. DEPARTMENT OF AGRICULTURE

## THE SILVICAL REPORTS

During 1907 and the following several years the U. S. Forest Service issued a series of silvical leaflets which covered the broad characteristics of a considerable number of major timber species. Since then much new knowledge has accumulated--some of it published in a variety of sources. There is also a considerable store of unpublished silvical information in the files of the forest experiment stations, the forest schools, and some other agencies. To compile this information systematically and make it available to foresters generally, the Lake States Forest Experiment Station is preparing reports on 15 individual species. Similar reports are being prepared by the other Federal forest experiment stations. When completed, these individual species reports will provide the basis for a comprehensive manual of silvics for the important trees of the United States, to be published by the U. S. Forest Service.

This report is one of the series being prepared by the Lake States Station. A preliminary draft was reviewed by several members of our own Station staff and by a number of well qualified staff members of other forest experiment stations, colleges, and universities; Federal, State, and Provincial forestry organizations; and forest industry. Their comments helped the author to make this report more complete, more accurate, and more up to date. Especially helpful reviews were submitted by Professors Grant Cottam and J. T. Curtis, Department of Botany, University of Wisconsin; G. A. Limstrom, Central States Forest Experiment Station; R. U. Swingle, Ornamental Crops Field Station, Agricultural Research Administration; and E. I. Roe, Lake States Forest Experiment Station.

Every effort has been made to ensure the accuracy and completeness of the information concerning the silvical characteristics of each species consistent with a brief treatment of the subject. We shall appreciate it, however, if any errors or omissions of important information are brought to our attention.

M. B. Dickerman

M. B. Dickerman, Director

Cover: A typical mature slippery elm in southwestern Wisconsin and drawing of leaves.

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# SILVICAL CHARACTERISTICS OF SLIPPERY ELM

(*Ulmus rubra* Mühl.)

By

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Slippery elm is one of six elms native to the United States. Other common names include red elm, gray elm, soft elm, moose elm, red-wooded elm, rock elm, and Indian elm (2, 9, 15, 16, 17, 22, 24).[2/]

## DISTRIBUTION

The botanical range of slippery elm extends from the Great Plains eastward to the Atlantic seaboard and northward to southeastern Ontario and extreme southern Quebec (17, 18) (fig. 1). It has very local distribution in Maine, New Hampshire, New Jersey, Delaware, North Dakota, and South Dakota; and the species is rare or absent in Florida, southern Georgia, southern Alabama, southern Mississippi, most of Louisiana, and eastern Texas (17, 18). As a matter of fact, slippery elm is uncommon in that part of its range lying south of Kentucky and the Ozark Mountains of Missouri and Arkansas.[3/]

The species is most abundant, and its commercial importance highest, in the southern portions of the three Lake States and in the so-called corn-belt of the Midwest. For example, it was found to comprise 2.5 percent and 6.5 percent respectively of all sawtimber volume in Ohio and Iowa, and in the elm-ash-cottonwood forest type its volume as a percentage of the total board-feet per acre was even higher, being 6.6 per cent in Ohio and 8.6 percent in Iowa.[4/]

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1/ Maintained by the Forest Service, U. S. Department of Agriculture, at St. Paul 1, Minnesota, in cooperation with the University of Minnesota.

2/ Underlined numbers in parentheses refer to Literature Cited on page 12.

3/ Based on correspondence from J. A. Putnam of the Southern Forest Experiment Station to the Director, Lake States Forest Experiment Station, on March 12, 1956.

4/ Unpublished data, Central States Forest Experiment Station, Columbus, Ohio.

SLIPPERY ELM (Ulmus rubra)

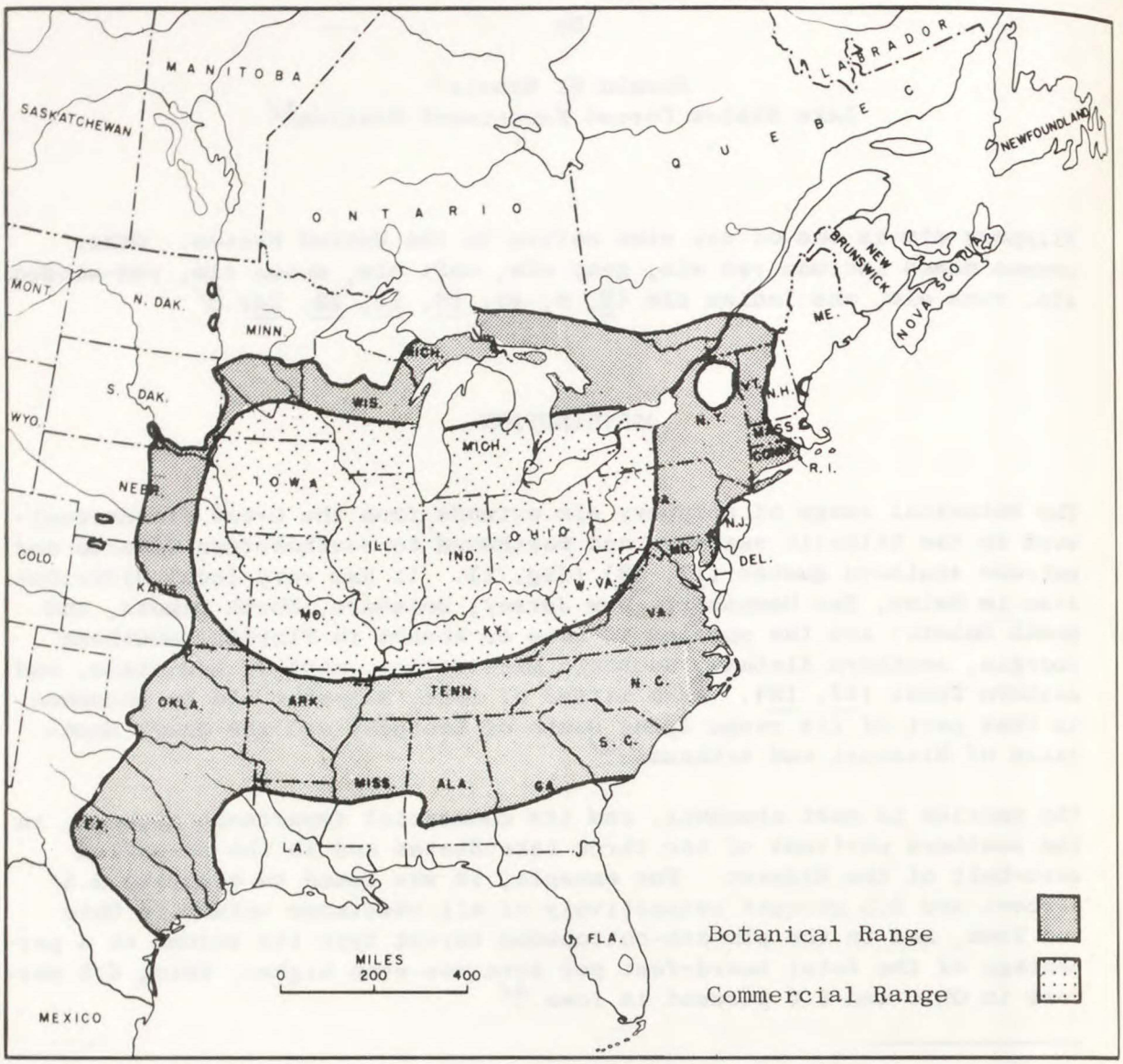


Figure 1.--Botanical and commercial range of slippery elm.

## HABITAT CONDITIONS

### Climatic Factors

Climatic conditions are strikingly different in various States where slippery elm is a native tree species (30). Annual precipitation increases from west to east, averaging about 21 inches along the North Dakota-Minnesota boundary to as much as 83 inches in the higher mountains of western North Carolina. The warm season (April to September) totals at these same geographic locations are 16 inches and 41 inches, respectively. Annual snowfall decreases from north to south, amounting to 100 inches or more in certain parts of the Lake States and New England to as little as 5 inches along the northern boundaries of the Gulf States.

Temperatures, based on general meteorological maps, vary about as follows: (1) Average annual, 40° to 60° F.; (2) average for January, 5° to 45°; (3) average for July, 70° to 80°; (4) highest on record, 100° to 115°; and (5) lowest on record, 0° to -50°.

The length of growing season (frost-free period) varies from 100 to about 240 days; it is shortest in the north central portions of the Lake States and longest in east central Texas and those sections of the Gulf Coast and Atlantic seaboard States where slippery elm is indigenous.

### Edaphic Factors

Four of the Great Soil Groups are represented in eastern United States (19) where slippery elm occurs. They include the Podzols, the Gray-Brown Podzolic soils, the Chernozems, and the Prairie soils. These soils vary from sands to clays and may be acid, neutral, or slightly alkaline.

Slippery elm appears to be more closely associated with local soil moisture conditions than with any particular genetic soil type. In Wisconsin, this tree is a component of the climax or subclimax forest on three soils in the Podzol region and two soils in the Prairie-Forest region (33). All five of these soils have a common profile characteristic, namely, a gley horizon at depths of 10 to 21 inches from the ground surface. Such layers are associated with recurrent seasonally-high water tables.

While slippery elm makes its best growth on the moist, rich soils of lower slopes, stream banks, river terraces, and bottom lands, it often is found on much drier sites, particularly those of limestone origin (15, 16, 26). Observations in southeastern Iowa, eastern Iowa, and Illinois seem to indicate that the species, in that part of its botanical range, is "more at home on relatively high, dry white oak sites" than in creek bottoms and coves.[5/]

## Physiographic Factors

Most of the area in which slippery elm occurs lies 500 to 1,800 feet above sea level (29). However, the species was found at elevations of about 2,000 feet in the southern Appalachian foothills (24). Farther north, the tree possibly may be found at even higher elevations since its botanical range includes all of Pennsylvania and Vermont (fig. 1) --and thus the more rugged portions of the northern Appalachians.

## Biotic Factors

Slippery elm is a common, though ordinarily scattered, timber tree in Society of American Foresters Forest Cover Types 39, 54, 56, and 62 (27).

Black ash (Fraxinus nigra), American elm (Ulmus americana), and red maple (Acer rubrum) are the key species in type 39. Northern red oak (Quercus rubra), American basswood (Tilia americana), and white ash (Fraxinus americana) are the principal species in type 54. Northern red oak, mockernut hickory (Carya tomentosa), and sweetgum (Liquidambar styraciflua) are the main components of type 56. Silver maple (Acer saccharinum) and American elm usually predominate in type 62.

Other common tree associates of slippery elm include: white oak (Quercus alba), swamp white oak (Q. bicolor), bur oak (Q. macrocarpa), rock elm (Ulmus thomasii), September elm (U. serotina), blue ash (Fraxinus quadrangulata), green ash (F. pennsylvanica), sugar maple (Acer saccharum), yellow birch (Betula alleghaniensis), black walnut (Juglans nigra), butternut (J. cinerea), honeylocust (Gleditsia triacanthos), black cherry (Prunus serotina), bigtooth aspen (Populus grandidentata), quaking aspen (P. tremuloides), eastern cottonwood (P. deltoides), American sycamore (Platanus occidentalis), yellow-poplar

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5/ Putnam: See footnote 3 on page 1.

(Liriodendron tulipifera), blackgum (Nyssa sylvatica), eastern hophornbeam (Ostrya virginiana), and eastern hemlock (Tsuga canadensis) (12, 15, 16, 27).[6/]

Blackberry (Rubus allegheniensis), blackcap raspberry (R. occidentalis), pasture and hairystem gooseberries (Ribes cynosbati and R. hirtellum), roundleaf, pagoda, redosier, and gray dogwoods (Cornus rugosa, C. alternifolia, C. stolonifera, and C. racemosa), beaked hazel (Corylus cornuta), leatherwood (Dirca palustris), ninebark (Physocarpus spp.), American bittersweet (Celastrus scandens), Virginia creeper (Parthenocissus quinquefolia), grape (Vitis spp.), hawthorn (Crataegus spp.), American and scarlet elders (Sambucus canadensis and S. pubens), nannyberry (Viburnum lentago), and witchhazel (Hamamelis virginiana) (1, 13, 21, 23) are representative woody shrubs on the forest sites where slippery elm occurs.

## LIFE HISTORY

### Seeding Habits

#### Flowering and Fruiting

The perfect flowers of slippery elm appear 10 to 15 days before the leaves during late February to early May, depending on geographic location and year-to-year variations of the growing season (31).

The winged samara, measuring about 3/4 inch in length, matures when the leaves on the tree are about half expanded (15). The fruit ripens and falls during April, May, and June, depending on locality and weather conditions (31).

#### Seed Production and Dissemination

Good crops of seed are produced at 2- to 4-year intervals, starting at a tree age of about 15 years, with optimum yields occurring from the 25th to 125th years. There are 35,000 to 54,000 clean, fully-ripened

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6/ Forest survey summary tables for Iowa and Ohio. Unpublished data, 1955, Central States Forest Experiment Station, Columbus, Ohio.

air-dry seed per pound, but their germination capacity is the lowest--4 to 34 percent--of any of our native elms. Little is known about the effect of dry storage on the viability of the fruit of slippery elm, but their average soundness of 96 percent indicates that more information is needed about the germination of this tree species. (31)

Small rodents, such as the striped ground squirrel (Citellus tridecemlineatus), eastern chipmunk (Tamias striatus), and northern white-footed mouse (Peromyscus leucopus), by reason of their general food-consumption habits (8, 14), probably consume a limited amount of slippery elm seed.

Wind and water are the principal agents in disseminating the fruit of this tree (28). The compressed nutlet is surrounded by a continuous membranous wing, which facilitates dispersal of the seed. While most of it falls within 1 or 2 tree-heights of the parent tree, this radius can be extended by strong gusts or updrafts of air. Both wind and water concentrate elm seed in depressions, at the base of sloping rocks, etc., where it is easily collected for nursery use (28).

## Vegetative Reproduction

Slippery elm reproduces readily from stump sprouts and has the added peculiarity of spreading vegetatively by interconnected rhizomes during its seedling stage.[7/] "Seedlings" 2 feet or less in height sometimes form in this manner in patches 30 feet or more in diameter.

Rootstocks of this species often are used by nurserymen in propagating hybrid elms.[8/] Layered elm is reported to form roots in 1 year (28).

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7/ Correspondence of March 8, 1956, from Dr. J. T. Curtis, Botany Department, University of Wisconsin, to the Director, Lake States Forest Experiment Station.

8/ Correspondence of April 26, 1956, from Roger U. Swingle, Agricultural Research Service, to Director, Lake States Forest Experiment Station.

## Seedling Development

### Establishment

Slippery elm is a relatively common tree, especially in the so-called corn-belt or Midwestern States. With the exception of aspen and paper birch (Betula papyrifera), slippery elm reproduces more successfully in the farm woodlands of southeastern Minnesota, under a wide range of site conditions, than any other tree species according to a study by Deters (12). He showed that slippery elm comprised 27.4 percent of all regeneration in valleys and coves and from 3.3 to 11.0 percent elsewhere.

Mineral soil is the best medium for quick germination and initial establishment of slippery elm seedlings, but the tree likewise is found on many sites where the soil is covered with forest litter or grass and other herbaceous plants.[9/] The seed of this species sometimes shows dormancy (31).

### Early Growth

There is little, if any, published information relative to the annual height growth of slippery elm during its seedling stage. However, studies in the woodlands of southeastern Minnesota showed that these juveniles grow well in the open or under light shade at rates slightly higher than for American elm (12). Trees 1 inch in diameter at breast height were 7 to 18 years old, depending on the degree to which they were suppressed by competing vegetation.

Young slippery elm seedlings are quite susceptible to damping-off fungi (5).

## Sapling Stage to Maturity

### Growth and Yield

Slippery elm makes its most rapid height growth when the trees are 8 inches or less in diameter (table 1).

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9/ Unpublished information, Lake States Forest Experiment Station.

Table 1.--Average total height of slippery elm by d.b.h. class, Crawford County, Wis.[1/]

| Diameter at breast height | Total height | Diameter at breast height | Total height |
|---|---|---|---|
| Inches | Feet | Inches | Feet |
| 1 | 8 | 8 | 61 |
| 2 | 18 | 10 | 67 |
| 3 | 28 | 12 | 70 |
| 4 | 37 | 14 | 72 |
| 5 | 44 | 16 | 74 |
| 6 | 51 | | |

1/ Unpublished data of the Lake States Forest Experiment Station. Curved values for 47 trees.

On the average site, slippery elm attains a height of 60 or 70 feet and diameters of 2 or 3 feet (15, 16, 22, 24). However, under ideal growth conditions individual trees may be 135 feet tall and 4 feet at d.b.h. (9). Currently, the largest authentic specimen, located in Allegheny County, Pa., has a total height of 75 feet, a crown spread of 75 feet, and a circumference of 16 feet 5 inches at breast height--approximately 63 inches in diameter (4). A tree in Richland County, Wis., is 44 inches in diameter, 40 feet in clear length, and about 90 feet in total height.[10/]

This species occurs typically as scattered individuals in mixture with other hardwoods (fig. 2), although occasionally it may be the dominant species on especially favorable sites. Under these conditions, its per-acre yield may vary from less than 100 board-feet to 2,000 or 3,000 board-feet.

Slippery elm is reported to attain a maximum age of about 200 years (31).

10/ Unpublished data, 1955, Lake States Forest Experiment Station.

Figure 2.--Slippery elm occurs in mixture with sugar maple, American elm, rock elm, northern red oak, white ash, American basswood, and butternut in this timber tract located in Pierce County, Wis. The 20-inch tree with axe partially buried in its bark is typical of the species in the west central part of the State.

## Reaction to Competition

Sample plot studies on the Apple River Timber Harvest Forest in Polk County, Wis. show that the diameter growth of slippery elm is materially reduced by suppression.[10/] Thus intermediate and suppressed stems of sapling and small sawtimber size increased only 0.43 inch in diameter in 8 years, whereas trees in the codominant and dominant crown classes grew 1.14 inches, almost three times as fast, during the same period. This same growth reaction to competition was observed in the farm woodlands of southeastern Minnesota (12). Slippery elm can maintain itself in "terminal stand environments"--subclimax or climax forests--as shown by its high "climax adaptation number of 8.0 as compared to 10.0 for sugar maple and 1.0 for quaking aspen" (11).

## Limiting Factors

Insufficient annual precipitation, low year-round humidity, and extremely high summer temperatures are limiting factors in the natural distribution of slippery elm. This species and American basswood drop

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10/ Unpublished data, 1955, Lake States Forest Experiment Station.

out of the natural forest communities in the Great Plains States in areas of 16 to 24 inches of yearly precipitation (1).

Slippery elm is attacked and killed by Dutch elm disease (Ceratocystis ulmi) (3, 7). It also may succumb to wilt caused by the fungus Verticillium and occasionally is killed by dieback (Dothiorella ulmi) (20). Other diseases that affect the leaves, twigs, and wood but seldom kill the tree include leaf spot (Gnomonia ulmea) (7), brown wood rot (Pleurotus ulmarius), white flaky rot (P. ostreatus), Ustulina butt rot (Ustulina vulgaris), slimeflux and wetwood (Erwinia nimipressuralis), and nectria canker (Nectria galligena) (5).

The insect enemies of slippery elm include four wood borers that damage living trees but rarely kill them. These are: Native elm bark beetle (Hylurgopinus rufipes), elm borer (Saperda tridentata), red elm bark weevil (Magdalis armicollis), and black elm bark weevil (M. barbita) (10). While these borers may not destroy a large volume of wood in an absolute sense, they cause substantial economic losses by lowering the quality of lumber and other sawn products.

Spring cankerworm (Paleacrita vernata), fall cankerworm (Alsophila pometaria), forest tent caterpillar (Malacosoma disstria), and elm leaf beetle (Galerucella xanthomelaena) are the principal defoliators of slippery elm (10).

It also is subject to infestations of several of the aphids, namely, elm cockscomb gall aphid (Colopha ulmicola), elm leaf aphid (Myzocallis ulmifolii), woolly elm aphid (Eriosoma americanum), and woolly elm bark aphid (E. rileyi) (34). These pests are unsightly, but they do little real damage to forest-grown trees.

Ring shake is a common defect in slippery elm, and because of it overmature trees are often worthless for lumber or other sawn products.

## SPECIAL FEATURES

Slippery elm derives its name from the fragrant, mucilaginous inner bark to which the early settlers ascribed various attributes. It was considered somewhat nutritious and was chewed to allay thirst (16). In the powdered form, it was used in dressing wounds or for poultices, and, when steeped in water, was taken internally for throat inflammation and fever (15, 22). The inner bark still is used to a limited extent for medicinal purposes.

Well-masticated slippery elm bark often was a requisite for the "spit"-ball pitcher in professional baseball until this practice was banned by changes in the rules of the game.

At 15 percent moisture content the hard strong wood of slippery elm weighs approximately 38 pounds per cubic foot (32). Its heartwood is "dark brown with shades of red" and the sapwood is "nearly white". The wood is durable in contact with the soil and is used for railroad ties and fence posts (9). It also is utilized for piling, planking, agricultural implements, and furniture (6). The local and domestic use of this species reportedly exceeds its commercial use in most localities, the wood being "highly-esteemed for farm use, ranking next to ash for wagon tongues, reaches, etc."[11/]

## RACES, HYBRIDS, AND OTHER GENETIC FEATURES

No studies of racial diversity have been reported for this species, but in view of its wide and scattered distribution ecotypes or races probably will be discovered. Vegetative cells of ordinary wild slippery elms contain 28 (14 pairs) chromosomes (25).

Artificial crosses commonly are made between slippery elm and Siberian elm (U. pumila),[12/] and natural hybrids involving rock elm and slippery elm have been observed in Sawyer County, Wis.[13/]

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11/ Putnam: See footnote 3 on page 1.
12/ Swingle: See footnote 8 on page 6.
13/ Curtis: See footnote 7 on page 6.

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## SILVICAL REPORTS PUBLISHED OR IN PROGRESS

In addition to the present paper on slippery elm, the Station has published silvical reports as follows:

| | |
|---|---|
| Station Paper 44 | Red pine |
| Station Paper 45 | Black spruce |
| Station Paper 47 | Rock elm |
| Station Paper 49 | Quaking aspen |
| Station Paper 50 | Sugar maple |
| Station Paper 52 | Tamarack |
| Station Paper 54 | American elm |
| Station Paper 55 | White spruce |

Ensuing reports will cover the following species:

| | |
|---|---|
| Jack pine | Balsam poplar |
| Basswood | Northern white-cedar |
| Bigtooth aspen | Black maple |

SOME RECENT STATION PAPERS

Guide for Selecting Superior Forest Trees and Stands in the Lake States.
Paul O. Rudolf.
Station Paper 40, 32 pp., illus. 1956.

Chemical Control of Brush and Trees in the Lake States.
Paul O. Rudolf and Richard F. Watt.
Station Paper 41, 58 pp., illus. 1956.

Wood Pallets in the Minneapolis-St. Paul Area: An Outlet for Low-Grade Hardwoods.
John R. Warner and D. R. Cowan.
Station Paper 43, 34 pp., illus. 1956.

The Market for Domestic Charcoal in Wisconsin.
John R. Warner and William B. Lord.
Station Paper 46, 15 pp., illus. 1957.

Natural Regeneration on a 2-Acre Mixed-Oak Clear Cutting Five Years After Logging.
Harold F. Scholz and A. J. DeVriend.
Station Paper 48, 11 pp., illus. 1957.

Deterioration of Sugar Maple Following Logging Damage.
Gene A. Hesterberg.
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A Record of the Timber Cut from Forests of the Lake States, 1954.
Arthur G. Horn.
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Marking Guides for Northern Hardwoods Under the Selection System.
Carl Arbogast, Jr.
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